Behavioral Ecology in the Classroom

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Behavioral Ecology in the Classroom*†

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Abstract: Many investigators have been interested in the use of individual contingency management procedures to remediate undesirable classroom behavior, but far less attention has been paid to the impersonal variables or setting events that often engender inappropriate behavior in the classroom. The present studies explored the effects of two impersonal, ecological variables upon the behavior of black kindergarten children from a segregated, low-income neighborhood. Experiment I demonstrated that when children's seating arrangements were crowded, or when they were required to crowd around a teacher's demonstration, their visual attendance to the teacher and/or to the educational materials was markedly reduced. A second experiment showed that visual attendance to a teacher and/or to the books throughout a story period was markedly lower when this academic session had been preceded by a period of vigorous activity than when preceded by a rest period; and transition times were longer and more disruptive following vigorous activities. When individual contingency

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management techniques were used, in both of these studies, to remediate the undesirable behaviors that occurred in the presence of unfavorable environmental conditions, the impersonal ecological arrangements were shown to be as effective and efficient in producing desired behavior change as these standard behavior modification procedures. These findings suggest that environmental arrangements may become as important a focus for applied behavior analysis as contingency management systems have been.

Within the areas of early childhood care and education, much has been written about the importance of creating physically attractive environments and general milieus that will result in social and intellectual growth for children. Many authors advance recommendations concerning the physical plant, daily program scheduling, and equipment and materials (e.g., Evans, Shub, & Weinstein, 1971; Leavitt, 1958; Leeper, Dales, Skipper, & Witherspoon, 1968), but often these recommendations are simply rooted in educational tradition and stand without empirical support.

Cruickshank and Quay (1970) point out that, on the surface, school planning and construction appear to be founded upon defined educational, architectural and construction goals, and indeed, design dimensions such as air circulation, cubic footage, lighting and building materials are usually carefully specified and researched, but not for questions of their effects upon child behavior. If educational outcomes are considered at all during planning and construction, input usually comes from anecdotal evidence supplied by teachers and school administrators, and not from any systematic observation that could establish empirical relationships between environmental arrangements and child behavior.

Sommer (1971) suggests that many aspects of classrooms and care settings are designed for ease of maintenance and efficiency of cleaning, with little cognizance of social functions. In addition, traditional physical arrangements often persist, although the rationales that led to their construction are no longer salient.

Even if educators and child care workers are aware of the richness and diversity of recent architectural innovations, their choices among these new design alternatives are usually a matter of guesswork, since there has been little empirical analysis of the types of physical facilities that support child care or educational goals (Barker & Gump, 1964; Doke, unpublished).

When writers in the area of early childhood education discuss the physical features of a classroom or day care setting, these are usually treated separately from desired program outcomes, with little or no

consideration of the relationships between specific classroom designs or program characteristics and child behavior patterns. It is precisely at this interface between environmental components and behavioral outcomes that an ecological perspective becomes invaluable (Sells, 1969).

Recently, applied behavior analysts have become increasingly interested in explorations of the effects of impersonal, ecological variables upon behavior in natural settings (cf. Becker, Engelmann, & Thomas, 1971; Orme & Purnell, 1970; Tharp & Wetzel, 1969). Such ecological investigations employ the observational and experimental analysis of behavior in applied settings. For example, Cohen (1968), an architect-behavioral psychologist, uses behaviorally-based observation and time sampling procedures to examine the relationships between physical design and human behavior.

At the University of Kansas, the members of the Living Environments Group have also employed applied behavior analysis technology in exploring ecological variables pertaining to the design of living environments for dependent populations. Technologies have been developed for improving the quality of such environments as an infant day care center (Cataldo & Risley, 1974; LeLaurin, Cataldo, & Risely, in press; Twardosz, Cataldo, & Risely, 1974a, b); a toddler day care center (Twardosz, Cataldo, & Risley, 1974b, 1975); a preschool (Risley, 1971; Doke & Risely, 1972; Hart & Risely, 1974; Montes & Risely, in press; LeLaurin & Risley, 1972); a recreation program for disadvantaged children and adolescents (Pierce & Risely, 1974a, b; Quilitch & Risely, 1973); and a nursing home (McClannahan & Risely, 1973, 1974, 1975, in press). These studies use direct observation and measurement to obtain descriptive data on environmental dimensions and behavioral characteristics, and proceed from descriptive data to experimental manipulation of specific ecological variables within the living environments.

The studies presented in this paper are a part of this larger project; specifically, they are designed to show the relationships between classroom environmental variables and the preacademic or social behaviors of kindergarten children. Observations in many kindergartens, and interviews with kindergarten teachers were the basis for the choice of behaviors to be measured, as well as the selection of environmental variables to be manipulated.

During preliminary observations and interviews, it became apparent that in many kindergarten classrooms, there are particular activities and particular time periods during the day when the teachers consistently experience difficulties in implementing their

program. It appeared that at these times, teachers arranged the environment in ineffective ways that, in fact, set the occasion for those behaviors that they least desired. The research presented below identified and manipulated some of the environmental variables that are associated with these disruptive occasions in the classroom.

EXPERIMENT I: EFFECTS OF SPATIAL DENSITY DURING TWO CLASSROOM ACTIVITIES

The physical environment often affects the manner in which persons arrange themselves in relation to one another, and these human arrangements may subsequently give rise to specific response patterns (Eastman & Harper, 1971; Hall, 1963). Ecological studies of the interactions between human arrangements and behavior often employ the concepts of social and spatial density. The term "social density" refers to the number of people per unit space, while "spatial density" refers to the amount of space per person.

Experimental studies of the behavioral effects of population densities on young children have most often measured aggression and group interaction. Although the results have not been totally consistent, in general they indicate that: (1) crowded conditions result in increased incidence of aggression (Jersild & Markey, 1935; Hutt & McGrew, 1967); and (2) high density situations produce decrements in close personal contacts among group members (Hutt & Vaisey, 1966; Loo, 1972; McGrew, 1970).

Most kindergarten teachers who were observed prior to the initiation of this study conducted story or lesson activities by asking children to come and sit cross-legged and in close physical proximity on the floor in front of their chairs. With a group of children crowded together and competing for limited space, the usual outcome was poking, shoving and failure to attend to the teacher and/or to the presented materials. It appeared that crowded conditions set the occasion for disruptive and inattentive behaviors that were incompatible with the acquisition of academic responses.

Similarly, observations in kindergarten classrooms indicated that project demonstrations were also occasions for crowding children together. Children were typically asked to gather around the teacher and visually attend to her and to the materials she was presenting. Again, children who were competing for limited space and visual access exhibited a variety of inattentive and disruptive behaviors.

These observations in the natural environment suggested that

spatial arrangements and population densities might have important effects upon children's classroom behavior. Thus, the present study compared the effects of crowded versus uncrowded conditions on students' on-task behavior during two classroom activities, story periods and project demonstration sessions.

Method

Subject and Setting

The subjects for Experiment I were black children who had recently completed kindergarten in a segregated low-income neighborhood. The five boys and three girls who participated in these studies began to attend supplementary kindergarten sessions at Turner House Preschool immediately following the last day of the school year. Sessions were conducted for two and one-half hours per day, five days per week. The physical setting, as well as the daily routine, was designed to simulate a typical public school classroom. Each weekday, the children participated in both a story period and a demonstration session, during which spatial arrangements were manipulated.

Story Periods

In order to test the effect of spatial density during story period, crowded and uncrowded seating arrangements were alternated daily, or every two days, in an equivalent time-samples design (Campbell & Stanley, 1963). During uncrowded conditions, the teacher asked the children to come to the rug in the story area and sit cross-legged on squares of masking tape placed two feet apart. During crowded conditions, a blanket was folded to 3 feet by 4 feet and placed on the rug, and the teacher instructed children to sit cross-legged on the blanket.

In order to insure that the spatial dimension was the only difference between conditions, the following variables were held constant across both crowded and uncrowded seating arrangements: (1) teacher, blanket and rug always occupied the same positions within the story area; (2) the children were not arranged in any specific seating sequence in either condition; (3) the teacher did not prompt or reinforce attentive behavior, nor did she respond to disruptive behavior in either condition; and (4) the same books and teacher were used during both conditions, to control for story content and possible teacher and story preferences.

On-task behavior during story period was defined as sitting cross-legged, visually attending to the teacher or to the materials presented, and not engaging in any disruptive behavior. Observations were made throughout the entire 15-minute story period, using a procedure of time sampling at a point in time. Observers located behind a one-way mirror observed the children every 30 seconds, and scored each child as being on-task or off-task at that point in time. Children were always observed in a predetermined sequence of left to right, and front row to back row.

Each session yielded the percent of time samples during which each of the eight children was scored as on-task. These percent figures were then averaged to obtain mean percent on-task behavior per day.

Measures of interobserver agreement were obtained during six story sessions; three during crowded and three during uncrowded conditions. Within each session, each pair of observations was scored as an agreement or as a disagreement, and interobserver agreement was computed according to the formula: total number of agreements divided by agreements plus disagreements, multiplied by 100. Interobserver agreement during story periods ranged from 86 percent to 97 percent with mean agreement of 94 percent.

Project Demonstration Sessions

During project demonstration sessions, the teacher showed the eight children how to use arts and crafts materials that were distributed to them immediately following her demonstration. In uncrowded project demonstration sessions, the teacher asked the children to sit in a semi-circle about one foot apart; in this arrangement, they were equidistant from each other and from the teacher, who sat in the center. In crowded project demonstrations, the teacher asked children to gather around behind her as she sat at a low table. The first three project demonstrations were done under uncrowded conditions; the next two under crowded conditions; subsequently, crowded and uncrowded conditions alternated daily, in an equivalent time-samples design.

The following variables were controlled during both uncrowded and crowded sessions: (1) the same teacher conducted all project demonstration sessions; (2) the same arts and crafts activities were demonstrated in both conditions; (3) children were always instructed to watch the teacher, so that they could do the project themselves following the demonstration; (4) children were not assigned positions in either condition; and (5) the teacher did not prompt or reinforce

appropriate behavior, nor did she attend to disruptive behavior in either condition.

A child was defined as on-task during project demonstration sessions if his head was oriented in the direction of the teacher, if he was seated during the uncrowded demonstration and standing in the assigned area during the crowded demonstration, and if he was not engaging in any disruptive behavior. Observers stationed behind a one-way mirror recorded whether each subject was on-task or off-task; observations were made every 30 seconds throughout the project demonstration, using a procedure of time sampling at a point in time. Again, children were always observed in a predetermined sequence. Individual children's percentages of on-task behavior were averaged to obtain mean on-task behavior for each day.

Reliability estimates were obtained in four crowded and three uncrowded sessions and were calculated using the same formula used for story sessions. Interobserver agreement ranged from 90 percent to 100 percent, with mean agreement of 97 percent.

Remediation of Off-Task Behavior under Crowded Conditions

As indicated earlier, equivalent time-samples designs were employed both in story and project demonstration sessions, in order to assess the effects of crowded vs. uncrowded conditions upon children's on-task behavior. Subsequently, a multiple baseline design across activities was used to determine whether children's inappropriate classroom behavior under crowded conditions could be remediated, using standard contingency management procedures.

During this phase of the experiment, all procedures described earlier for story period and project demonstration sessions remained the same, with the exception that descriptive praise from the teacher and classroom privileges were delivered contingent upon children's on-task behavior during crowded conditions. Descriptive praise included compliments by the teacher to the effect that a child was "looking at the book," "sitting quietly," or "watching carefully." Immediately following story and project demonstration sessions those children who had been on-task were permitted classroom privileges which were paired with verbal contingency statements such as, "Johnny, since you always looked right at the teacher, you may [be first in line," or "feed the turtle," etc.].

Descriptive praise and classroom privileges were introduced first in project demonstrations and later in story periods. However, uncrowded conditions were used as probes on three days during project demonstrations and on one day during story period. On days

when uncrowded conditions were implemented as probes, on-task behavior was not consequated with praise or privileges.

Interobserver agreement on measures obtained during remediation ranged from 91 percent to 97 percent, with mean interobserver agreement of 93 percent.

Results

During both story periods and teacher demonstrations, children's levels of on-task behavior were found to be significantly higher under uncrowded conditions. While contingent teacher praise and classroom privileges successfully reduced off-task behavior under crowded conditions, these procedures were no more effective than the simple environmental tactic of separating children from one another.

Crowded vs. Uncrowded Conditions

The lower graph of Fig. 1 shows the subjects' mean percent on-task behavior during story periods under both conditions. During days of uncrowded conditions, on-task behavior was always higher, averaging 88 percent across all days. The grand mean for on-task behavior during crowded conditions was 60 percent ($T = 2.36$, $df = 26$, $p < .05$).

Mean percent on-task behavior during project demonstrations under both conditions is shown in the upper graph of Fig. 1. Again, on-task behavior was always significantly higher under uncrowded conditions than under crowded conditions, averaging 50 percent ($t = 6.38$, $df = 14$, $p < .01$).

Remediation of Off-Task Behavior under Crowded Conditions

The right-hand portions of Fig. 1 show the effects of introducing teacher praise and classroom privileges contingent upon on-task behavior under crowded conditions during both story periods and teacher demonstrations. During teacher demonstrations, such contingencies increased the level of on-task behavior from a grand mean of 50 percent during baseline to a grand mean of 88 percent during treatment. Similarly, during story periods the level of on-task behavior under crowded conditions rose from a grand mean of 60 percent during baseline to a grand mean of 92 percent when contingencies were applied.

During the treatment phase of the study, children were exposed to uncrowded conditions and no contingencies for three days of

teacher demonstrations and one story period. The children's on-task behavior on these uncrowded probe days was consistently high, averaging 92 percent during teacher demonstrations and 95 percent during the story period, even though on-task behavior was not reinforced.

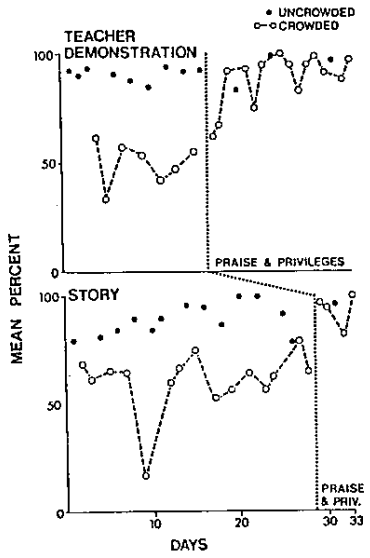

Fig. 1. Mean percent on-task behavior during teacher demonstration and story. During teacher demonstrations, on-task behavior was defined as being in the assigned area with head oriented toward the teacher and not engaged in disruptive behavior; and during story periods, on-task behavior was defined as sitting cross-legged, visually attending to the activity, and not engaged in disruptive behavior. In general, children remained on-task for a considerably greater percentage of the time when conditions were uncrowded (solid circles) than when they were crowded (open circles connected by dashed line). However, when descriptive praise and classroom privileges were introduced as consequences for on-task behavior, high levels of appropriate behavior were maintained even under crowded conditions.

Discussion

In both story periods and teacher demonstrations significantly higher levels of on-task behavior were obtained during uncrowded than during crowded conditions. When descriptive praise from the teacher and the awarding of classroom privileges were used to reinforce on-task behavior during crowded conditions, differences in behavior during crowded and uncrowded conditions disappeared, indicating as expected that reinforcement procedures can be effective in remediating the inappropriate behaviors that occur when environmental arrangements are unfavorable. However, the data clearly show that simple ecological arrangements were as effective as individual contingency management procedures in producing appropriate classroom behavior.

EXPERIMENT II: EFFECTS OF ACTIVITY SEQUENCE ON CLASSROOM BEHAVIOR

Although much has been written about curriculum and content of activity periods, very little attention has been given to the possible effects of the sequence in which activities occur. The most frequently offered opinion is that children will be more attentive and less disruptive if the daily activity schedule is arranged so that active periods alternate with periods of quiet (Becker et. al., 1971; Hambilin, Mukerji, & Yonemura, 1967).

However, it might be hypothesized that alternating periods of gross motor activity and periods of quiet set the occasion for inappropriate behavior as children make the transition from one activity to another. For example, the child who is asked to come in from recess and take a nap must make rapid and radical adjustments in behavior in order to conform to classroom rules.

The present study examined these conflicting assumptions by manipulating classroom activity sequence.

Method

Subjects and Setting

The subjects for Experiment II were the same eight children who participated in Experiment I, and the two and one-half hour kindergarten sessions, held at Turner House Preschool each weekday

afternoon, were again designed to simulate those of a public school classroom.

In order to investigate the effects of different activity sequences, two activity schedules were used: (1) eight minutes of an active session (either dancing, musical chairs or outdoor play) followed by transition to story and a 15-minute story period; and (2) eight minutes of an inactive session (children resting with their heads on their desks) followed by transition to a story and a 15-minute story period. These two activity schedules were alternated every day, or every two or three days, in an equivalent time-samples design (Campbell & Stanley, 1963).

To assure that observed differences in child behavior could be attributed to activity sequencing, the following variables were held constant across both activity schedules: (1) the same teacher participated in all sessions; (2) the teacher prompted participation, and praised children for participating in the first activity of each sequence, whether that activity was active or inactive; (3) the teacher did not prompt or praise children for appropriate behavior during transitions or story periods, nor did she attend to disruptive behavior during transitions or story periods; (4) the teacher always began reading when all eight children were seated on the rug in the story area; and (5) the same stories were read in both activity schedules, in order to control for child preferences.

Transition Period Measures

Whether preceded by an active or an inactive session, transition period measures were always taken while children moved from the table area in the classroom to the rug in the story area. The teacher initiated transition periods by giving the instruction, "Everyone go and sit on the rug for story time now," and the transition measure ended when all eight children were seated on the rug in the story area.

Two child behaviors were measured during transition—transition time from table area to rug in story area, and disruptive behavior during transition. Observers stationed behind a one-way mirror started their stop-watches when the first child left the table area and stopped their watches when all children had been seated on the rug for five seconds. The same observers counted the frequency of disruptive behaviors during transition. Disruptive behaviors were defined as running, kicking, hitting, shoving, tripping, wrestling, standing on furniture and throwing objects.

Measures of interobserver agreement were obtained for seven

days: four days when transitions were preceded by an active session and three days when transitions were preceded by an inactive session. Interobserver agreement on time of transition was calculated by dividing the smaller number of seconds by the larger number of seconds and multiplying by 100. Percent agreement ranged from 90 to 98; the mean percent interobserver agreement was 94. Interobserver agreement on the occurrence of disruptive behavior was computed by dividing the smaller number of occurrences by the larger number of occurrences and multiplying by 100. The range of interobserver agreement on disruptive behavior was from 83 percent to 100 percent, with mean interobserver agreement of 94 percent.

Story Period Measures

After all eight children had been seated on the rug in the story area for five seconds, transition period ended and the teacher began reading a story. During the 15-minute story period, observers located behind a one-way mirror made observations of children's visual attendance, using a procedure of time sampling at a point in time. Every 30 seconds, the observers looked at the children in a predetermined sequence and scored each child as visually attending if his eyes were open and his head was oriented in the direction of the teacher and/or book.

Estimates of interobserver agreement were obtained on four days when the story period was preceded by an active session and on three days when the story period was preceded by an inactive session. For visual attendance, observers' data sheets were compared, and each pair of observations was scored as an agreement or a disagreement. Subsequently, percent interobserver agreement was obtained by dividing the total number of agreements by agreements plus disagreements, and multiplying by 100. Interobserver agreement on visual attendance ranged from 90 percent to 99 percent, with a mean interobserver agreement of 94 percent.

Remediation of Undesirable Behaviors following Active Sessions

In an effort to increase visual attendance during story periods and to reduce transition time and disruptive behavior following active play periods, contingent teacher praise and classroom privileges were introduced sequentially across story periods and transition times following active sessions in a multiple baseline design.

The consequences applied were identical to those employed in Experiment I. Children who made a rapid transition, did not engage in disruptive behavior, or visually attended to the teacher received

behavior-specific praise from the teacher (e.g., "I like the way you are looking at the book," and "You walked very nicely to the story area when I asked you to") as well as classroom privileges such as helping the teacher and occupying positions of leadership. Observation procedures were the same as those described earlier. Interobserver agreement on visual attendance ranged from 93 to 99, with a mean of 96; on transition time ranged from 92 to 96, with a mean of 94; and on occurrence of disruptive behavior ranged from 97 to 100, with a mean of 98.

Results

Children's behavior during transitions and story periods was found to vary significantly depending upon the preceding level of physical activity. In general, children's visual attendance to the story was significantly higher, the time needed for transition between activities and the level of disruptive behavior during transition significantly lower when preceded by a less active time. Contingencies were found to be effective in increasing acceptable behaviors following periods of high activity; however, such procedures are unnecessary if activities are sequenced so that active/play periods are not alternated with quiet periods.

Effects of Activity Sequencing

The top graph of Fig. 2 shows the children's mean percent visual attendance to the teacher and/or the books during story periods following active play periods and inactive periods. Grand mean percent visual attendance was 86 following inactive periods and 63 following active periods ($t = 2.73$, $df = 21$, $p < .02$).

The length of time taken for transition from either an active play period or an inactive period to story time is shown in the middle graph on Fig. 2. Following active play periods, it took an average of 35 seconds for transition, whereas only 19 seconds were required following inactive periods ($t = 1.71$, $df = 27$, $p < .10$).

The rate of disruptive behaviors per minute following both active and inactive periods is shown in the bottom graph of Fig. 2. The mean rate of disruptions followings active periods was 11.8 per minute; following inactive periods the mean rate was 1.4 per minute ($t = 2.03$, $df = 27$, $p < .01$).

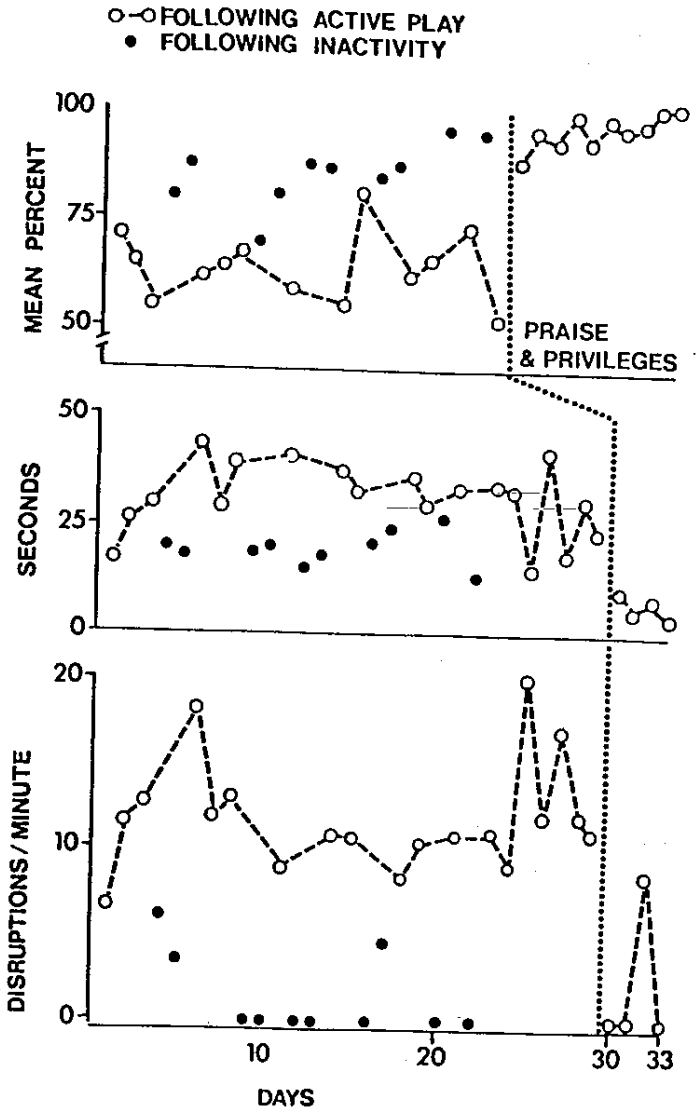

Fig. 2. The effects on children's behavior of scheduling a story period following both active play and sedentary activities: mean percent visual attendance to the story, time required for transition between activities, and level of disruptive behavior during transitions. Although the schedule which precedes the quiet story period with a sedentary activity was preferable in all cases, the provision of descriptive praise and classroom privileges for children whose behavior was appropriate was also effective.

Remediation of Undesirable Behaviors following Active Play Periods

When behavior-specific praise and privileges were used to consequate visual attendance, short transition times, and non-disruptive behavior, children's performance improved despite unfavorable activity sequencing, as can be seen in the right-hand portions of Fig. 2. Visual attendance during story periods preceded by active play periods, which averaged 63 percent during baseline, increased to a grand mean of 95 percent when visual attendance was consequated by the teacher. Similarly, time needed for transition decreased from an average of 35 seconds during baseline to only seven seconds, and the rate of disruptive behaviors decreased from a grand mean of 11.8 per minute during baseline to a grand mean of 2.1 per minute during treatment.

Discussion

Observations in the natural environment indicated that when kindergarten teachers scheduled a very active session, such as recess, immediately preceding a quiet period, such as story, they were more likely to encounter inappropriate child behavior than when the quiet period was preceded by a less active session.

The present study compared two activity sequences, active session-transition-story period and inactive session-transition-story period. When the former activity schedule was in effect, children's transition times were longer, there was a higher rate of disruptive behaviors during transitions, and visual attendance to the teacher and/or the educational materials was lower during the story period.

These results suggest that an activity that prohibits children from being physically mobile should not be immediately preceded by a session that permits or encourages boisterousness or large motor behavior. An optimally effective sequence of activities might schedule gross motor activities to be succeeded by creative play or seatwork sessions that allow freedom of movement and manipulation of materials, followed finally by a quiet session requiring restricted verbal and physical activity. Alternatively, a brief period of enforced inactivity and rest might be interspersed between a period of boisterous activity and a sedentary instructional session.

As in Experiment I, this study indicates that individual contingency management procedures can be used to obtain effective classroom performances under less than optimal environment condi-

tions. Of even greater importance, however, is the demonstration that the desired behavioral results can be obtained at lower response cost to the teacher through the introduction of simple but effective ecological arrangements in the classroom.

GENERAL DISCUSSION

The experiments presented here document the behavior change that can result from manipulation of ecological dimensions in the classroom. Because such behavior change strategies rely on alteration of impersonal variables, they do not require large expenditures of resources in the area of teacher training, nor do they result in the extra response cost to the teacher that may be associated with the use of individual contingency management procedures. Further, rearrangements of the classroom environment can often be achieved regardless of the educational models or theoretical orientations that are espoused by school personnel.

Manipulation of spatial density and activity sequencing produced effects comparable to those achieved with more traditional reinforcement procedures, thus obviating remedial measures that focus on consequent stimuli. These findings indicate that attention to setting events may result in the development of classroom environments that generate and maintain desired child behaviors.

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